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ABSTRACT

The behavior of approximately 50 employees learning to use a Los Alamos National Laboratory personnel information system with fixed-format and context-sensitive online help was monitored between October of 1984 and June of 1985. Data was gathered through direct observation during training workshops and during actual use, logging of consulting phone calls, and interviews. Information was sought to determine the following: (1) the type of training that would produce the greatest amount of learning for these users and their preferred learning styles; (2) how frequently they accessed online help; (3) the number of consulting calls that could have been answered by online help and the learning styles of the frequent callers; (4) ways to improve online help; and (5) whether the time invested in generating extensive online help was cost effective. Three preferred styles of learning were exhibited by users, and it was found that those with a guided discovery learning style were the most willing to access online help, users with a discovery learning style tended to enter an option to see what happened instead of accessing help, and the structured style learners were more nervous about using function keys and accessed online help the least. The context-sensitive help tended to be accessed when users were in trouble, and it seemed to be more frequently accessed and more useful to learners than the more general fixed-format help. It was also found that help that is context-sensitive (but not "intelligent") does not require major increases in software development resources. (DJR)

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LEARNING STYLES AND EMBEDDED TRAINING: A CASE STUDY

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ABSTRACT

The use of online help systems as a form of training is recent, with the emergence of embedded training. Embedded training reduces the need for mode changes. More study of user behavior with embedded training systems is needed for design considerations. This study reports on user behavior with fixed format and context-sensitive online help on a Los Alamos National Laboratory information system and suggests that user learning style is a key determinant for the design of embedded training.

INTRODUCTION

The realization that online help is a form of training for users of interactive computer systems has recently emerged (e.g., Fawcette, 1983; Stoddard, 1984; Heise, 1985; Kearsley, 1985). There are several reasons for this:

- The emergence of easier-to-use menu-driven and iconic interfaces has reduced the dependence on large printed reference manuals.
- The discovery, through user behavior studies, that many people do not learn effectively with printed documentation.
- The high cost of training, both in terms of the user's time investment and institutional costs of training, and management's desire to reduce training costs.
- The increase in the number of remote users of software.
- The advancements in software design resulting in the ability to integrate computer-based training and help with the actual system.
- The observation that mode changes required by separate training or help packages reduce user productivity.

Kearsley (1985) defined embedded training as "on-line instruction which is an integral part of a system or product; instead of isolating learning from what is to be learned, embedded training makes it an ongoing aspect of that system or product." As examples of embedded training he cites helps, simulations, and intelligent tutors, and he fully develops a rationale for why embedded training is the direction to head for in computer-based training. Because of the recency of embedded training (or online help seen as a form of training), few studies have been performed on user behavior with existing embedded training systems. Those that have been performed do not consider user learning style as a critical variable, but rather emphasize degree of prior computer experience only (e.g., Cohill and Williges, 1982; studies reported by Houghton, 1984).

The purpose of this paper is to describe a study of user behavior with fixed-format and context-sensitive help, which has been implemented on a personnel information system at Los Alamos National Laboratory, and to suggest that user learning style is a key determinant for the design of embedded training. User behavior was studied for a nine-month period (October 1984-June 1985) through direct observation, consultants' logs, and interview methodologies.

ONLINE HELP AS EMBEDDED TRAINING

At Los Alamos National Laboratory, a Department of Energy contractor with 7600 employees, a multi-functional and menu-driven set of information systems called INFORM has been developed for use by managers and administrators. For the more complex data entry systems, extensive documentation (in the form of walk-through quick guides) and live training in a computer classroom have been offered. Several different formats for training have been used and

evaluated, including computer-based training, traditional classroom instruction, and hands-on workshops (see Stoddard, 1985).

One personnel information system, called the Salary Review System, has been in production since December 1984. This system enables Laboratory managers to calculate and propose raises for their employees, to generate reports on employee data for use in their decision making, and to approve raises proposed by subordinate managers. The system was developed in-house, is written in COBOL, uses the forms management system (FMS) of Digital Equipment Corporation, and runs on VAX/VMS machines. Extensive online help is provided throughout the system. This online help is accessed in two ways:

1. *Fixed-format help: HE menu option*
The main menu of the Salary Review System contains 11 options that perform the system functions. One option is HE, which stands for HELP. When HE is typed at the cursor, the users are prompted for the option they want a detailed description of. They then type in a three-letter option code (e.g., RRP for raise review reports, CWA for change write access) and are given an informational screen describing the function and usage of that option (see Figures 1 and 2).

2. *Context-sensitive help: Help key from data entry screens*
If users press the PF2 key (on a VT100) or the F2 key (on an IBM PC), they receive one line of help information. This line either provides a description of the task at hand or what the next logical choices are. If users press this key twice, they receive a full screen of help information that describes in greater detail the current function and the various ways one can proceed. This help is context sensitive in that several different help messages and screens are available from each work screen; the message or help screen displayed is dependent upon where the user's cursor resides at that point in time on the screen (see Figures 3 and 4 for examples).

Users are made aware of the existence of the online help from screen prompts and the printed documentation. In addition, online help is discussed and demonstrated in the hands-on workshops provided for the system.

THE USERS

Approximately 350 Laboratory employees use the Salary Review System. The majority are managers (275), with the remainder being their administrative assistants and the Laboratory's personnel department staff. Because Los Alamos National Laboratory has an extensive scientific computing network, many of the Laboratory managers have extensive computer literacy on command language systems. In addition, many have recent experience using personal computers as administrative tools. A significant percentage of the population (20%), however, have had either little prior exposure to computers or only experience with electronic mail and word processing systems.

METHODOLOGY

User behavior has been monitored three ways: direct observation during workshops and during actual use, logging of consulting phone calls, and interviews. Information was sought to answer the following questions:

- What type of training most effectively produces the greatest amount of learning for these users? What are the preferred learning styles of these users?
- How frequently do users access online help or perceive they access online help?
- How many consulting calls received could have been answered by online help, and what learning styles do the frequent callers display?
- How can the online help be modified to better meet user needs?
- Was the time invested in generating the extensive online help cost effective?

Direct Observation During Workshops: Some students from each workshop (total 50) were observed to see if they spontaneously used the online help when they were in trouble, if they had even been aware of the availability of online help (learned through the verbal, screen, and printed prompts), and if the online help accessed answered the users' questions.

Direct Observation During Actual Use: On occasion, our user services staff has the opportunity to observe users using the system to perform the task of salary review or report generation. Observations here were the same as in workshops, but the setting was more natural for the users and thus a better indication of whether the online help would really be useful.

Consultants' Log: Users may call our consulting office during working hours to obtain answers to questions on data or usage and to report problems. The percentage of problem versus usage questions is noted. For some usage calls, it is noted whether the question could have been answered with the online help.

Interviews: Because user satisfaction is a high priority for our information system, the user services staff regularly discussed system design and efficiency with users. During many of these discussions, both in person and by phone, users were asked if they use the online help and if so how often and whether it was helpful.

```
                              MAIN MENU

        YOU HAVE THE FOLLOWING OPTIONS:

          SIA : Distribute SIA
          ROS : Roster worksheet
          CWA : Change write access
          CMS : Change management structure
          RRP : Enter raise report menu
          UID : User identification
          EAC : Enter the authority control menu
          BUL : Salary review system bulletin board
          MSG : Messages


          HE  : HELP
          LO  : LOG OFF SYSTEM
        ENTER THE DESIRED OPTION: HE
                                  SIA
```

Figure 1: Access to Fixed-Format Help.

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                        SIA : Distribute SIA

    This screen allows the signon manager to:
         - Allocate SIA to subordinate managers
         - View subordinate managers and their employees

    ALLOCATING SIA - the signon manager may distribute SIA to his/her
           subordinate managers.  In doing so the ALLOCATED and RESERVE
           amounts are calculated every time a TOTAL allocation for a manager
           is entered.

     VIEWING SUBORDINATE MANAGERS AND THEIR EMPLOYEES - the signon manager may
           view any one of his/her subordinate manager's managers and also a
           subordinate manager's employee's via the ROSter Worksheet screen


    The Salary Review System Quick Guide explains each function in more detail.

KEY CONTROLS:
PRESS THE RETURN KEY TO CONTINUE
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Figure 2: Example of a Fixed-Format Help Screen.

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F14-081D    LOS ALAMOS NATIONAL LABORATORY SALARY REVIEW SYSTEM        10/10/85
                    RAISE REVIEW REPORT MENU(RRP)


                        PSR : Produce Standard Report
                        PCR : Produce Customized Report


                        ENTER THE DESIRED PROCESS:
                        (enter PSR or PCR)


NEXT TASK:        (valid tasks are: SIA,ROS,CWA,CMS,RRP,EAC,BUL,MSG,HE,LO,MA,EX)
VALID KEYS ARE: <PF2>, <CTRL-E>, <RETURN>

Enter one of the selection types displayed on the screen
```

Figure 3: Example of One Line of Context-Sensitive Help: One Press of Help Key.

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                              PSR HELP SCREEN

TO SELECT ONE OF THE STANDARD REPORTS - this option provides a Structured
            Series report, a Staff Member report, a Jobcode report, and
            an Alphabetical report.

              - TAB to the desired report and press the RETURN key
              - the SOR option may be selected if you wish a different
                order sequence other than the default
              - select the CFL option and press the RETURN key
                (this will create the report)

              - enter NRP to select a report name
              - to find the status of the report repeat the first step
                above

              - if the report is available enter VRP in the ENTER SELECTION
                field ( this will display the report at the terminal)
              - press the CTRL key and the E key for the RRP RAISE REVIEW
                REPORT MENU
KEY CONTROLS:
PRESS HELP KEY (PF2) FOR VIEWING REPORTS INFORMATION; RETURN KEY FOR PSR SCREEN
```

Figure 4: Example of Full Screen of Context-Sensitive Help: Two Presses of Help Key.

Measures were all qualitative. An additional quantitative method of monitoring user behavior would have been useful: a software monitor which displays the frequency and context of use of the online help. Unfortunately, this was not done because of the lack of time to develop such a monitor and the overhead of such monitors resulting in a slowing of response time. The priorities of this system were meeting the schedule and providing a new system for managers. Although the lack of quantitative results does detract from the predictability of the results of this study, this study does represent a real-world situation where ongoing qualitative measures can significantly impact future work. The evaluation methodologies used here are commonly used in the fields of human factors in computing and cognitive psychology.

RESULTS

Learning Styles

Observations of users' preferred methods of learning how to use the Salary Review System revealed three preferred styles:

1. DISCOVERY LEARNING STYLE: Some users preferred to learn how to use the system completely on their own, with no formal training. These users log onto the system and browse, showing little computer anxiety. They tried the different menu options to see what happened and used printed documentation as a reference when they could not obtain answers from the screen. Use of the phone consulting service was reserved for questions not answered in documentation. These users tended to be somewhat impatient in their learning, desiring to learn system features only as they needed to use them.

2. GUIDED DISCOVERY LEARNING STYLE: These users preferred to learn by starting to use the system in a structured computer classroom or one-on-one training situation, but after a very short time learning the basics (15-30 minutes) they became impatient and wanted to discover more about the system on their own. They referred to the printed documentation step-by-step and then subsequently used it as a reference.

3. STRUCTURED LEARNING STYLE: These users would not begin using the system without formal classroom training. During the training they followed instructor directions carefully and referred to printed documentation when they were asked to do so. They discovered little about the system on their own, so thorough training on all system features was necessary. They often had difficulty finding the information they needed in the documentation and relied heavily on phone consulting after formal training.

User preferred learning style was determined through interviews and direct observation, therefore the categorization is subjectively based.

Frequency of Access of Online Help

Observations revealed a relationship between learning style and frequency of access of online help (see Table 1). Users with a guided discovery learning style seemed more willing to access online help than those with a discovery learning style. In turn, the structured learning style users seemed to access the online help the least.

The guided discovery learning style users learned of the availability of the online help through trainer announcements and documentation, and subsequently used it in addition to printed documentation. Interviews revealed that the discovery learning style users frequency of access of online help seemed dependent upon their prior preference of printed versus online documentation. A study performed at Los Alamos on a different help system suggested that users who were previously not familiar with online help tended to rely heavily on printed documentation, if they could readily locate it, whereas those who had previously used online help systems successfully tended to use online help more than printed documents (Stoddard et al., 1985). This same pattern could also be operating here, but further study is necessary to verify this hypothesis.

The structured learning style users revealed some computer anxiety, so they seemed reluctant to press any function keys for fear of making an unrecoverable error. This tendency seemed to disappear as the user became more comfortable with the system and if, on a one-on-one training basis, online help was frequently accessed and proven useful.

Context-Sensitive Versus Fixed-Format Help Frequency of Use

Of the two types of help available, the context-sensitive help seemed to be most accessed and most useful to users. The fixed-format help provided very general information on functionality of basic system options from the main menu. The method of accessing it is somewhat awkward in that one cannot browse sequentially through the help screens for all the options, but rather must separately request help (HE) and then the option name. The same information is easily browsed in the printed documentation. Discovery learning style users tended to find out about the function of options by entering the option itself to see what happened, whereas the guided discovery and structured users relied on description from the training or the printed document.

TABLE 1. Relationship of Learning Style to Help Accessed

Learning Style	Job Category	Frequency of HELP Access	Phone Consulting	Preferred Training	Printed Document
Discovery	more technical managers	moderately high	low, only for non-documented problems	self-study	used as a reference
Guided Discovery	more non-technical and technically oriented administrative assistants	high	moderate	formal, followed by self-study	for initial learning and as reference
Structured	more administrative assistants than managers	low	high	formal, followed by phone consulting	as a reference only if guide found useful during class

Context-sensitive help tended to be accessed when users were in trouble and did not know what to do next. Once it was accessed and was found to be useful for troubleshooting, users tended to remember to use it subsequently. Users who became accustomed to using the system without using the help key, however, tended to continue this pattern and not use it. The feature of obtaining an entire screen full of help upon pressing the help key twice was less frequently used. User interviews revealed that, in spite of its being documented, it seemed to be difficult to remember and illogical to press the help key twice when in trouble. Users had not seen this feature in other systems they had used, but expressed appreciation for being reminded about it in the interview. Thus, in spite of the fact that the users interviewed had been told of this feature during formal training, they rarely remembered it during independent use.

SUMMARY AND IMPLICATIONS

For the purposes of answering our initial questions, the results of this study suggest the following:

- Fixed-format help accessed from the main menu is less effective for user learning than context-sensitive help. It could be made more useful by making it easier to browse; that is, not require the user to type in each menu option when asking for HELP and offer all the help screens in succession (with the ability to return to the main menu at any time).
- The feature of the double press of the help key for obtaining more in-depth help was unnatural, although the full screen of help was judged by users as useful once they remembered how to get it. The interface should be modified, therefore, so that the full screen of help will be provided instead of one line of help when the task at hand is sufficiently complex.
- Printed documentation should be modified to include actual examples of help screens and messages.
- Formal training should include more frequent demonstrations of the online help during the hands-on session.
- When training is advertised for the system, the extensive online help feature of this system (combined with printed documentation) should be announced as well as the hands-on workshops to respond to the many users with discovery learning styles.

Several hypotheses can be formulated here that relate to the use of online help as a form of embedded training:

1. The frequency of access of online help is directly proportional to the degree to which the online help is proven useful in demonstrations, training, printed documentation, and prior use of online help.

2. The degree of usefulness of online help for learning a new system is directly related to the degree of naturalness of access to the help.

3. Learning style is an important variable when designing embedded training. Learning style is dependent not only on prior computer experience but also on a user's job and prior experience with online and printed computer documentation. Since it is experience-based, however, this variable must be viewed as dynamic within an individual.

4. If a system is well documented and has an easy-to-use interface, and if the user population is dominated by users with discovery or guided discovery learning styles, context-sensitive help may replace the need for formal training or more complex, structured computer-based training packages.

These hypotheses are useful on several counts. We can use them in our context for future planning of online help and for screening users for formal training. They are useful in other contexts because they suggest that the specific design of embedded training depends upon the dominant learning style of the user population. Thus, before embarking on a project to develop embedded training, project developers need to include criteria not normally examined in an audience analysis. These hypotheses are also useful to the research community in that they provide several specific areas where experimental studies could have a significant impact on the direction of embedded training. Our case study also demonstrates that commonly used evaluation methodologies are effective in collecting user behavior information for systems already in production.

The degree of needed sophistication of embedded training is a critical decision for the cost-benefit analysis in system development. As both Walker (1985) and Kearsley and Seidel (1985) point out, highly user responsive context-sensitive help requires a large effort, and instructional designer involvement at an early stage is required. Our case study demonstrated, however, that help which is context sensitive (but not "intelligent") does not require major increases in software development resources and yet it does seem to have a positive impact on ease-of-learning and ease-of-use. The recognition that the development of online help can be cost effective if integrated into other phases of the software life cycle is not new (e.g., Relles et al., 1981), and yet demonstration that embedded training will further enhance cost effectiveness is not fully recognized.

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